

AMORPHOUS SILICATES IN PRIMITIVE METEORITIC MATERIALS: ACFER 094 and IDPs. L. P. Keller¹, K. Nakamura-Messenger^{1,2} and S. Messenger¹ and ¹Robert M. Walker Laboratory for Space Science, ARES, NASA Johnson Space Center, Houston TX 77058 USA, ²ESCG/Jacobs Technology, Houston, TX, 77058. (Lindsay.P.Keller@nasa.gov).

Introduction: The abundance of presolar grains is one measure of the primitive nature of meteoritic materials. Presolar silicates are abundant in meteorites whose matrices are dominated by amorphous silicates such as the unique carbonaceous chondrite Acfer 094 [1, 2]. Presolar silicates are even more abundant in chondritic-porous interplanetary dust particles (CP-IDPs) [3]. Amorphous silicates in the form of GEMS (glass with embedded metal and sulfides) grains are a major component of CP IDPs. We are studying amorphous silicates in Acfer 094 matrix in order to determine whether they are related to the GEMS grains in CP-IDPs [4].

Methods and Samples: Fragments of Acfer 094 matrix were embedded in epoxy and thin sections (~70 nm thick) were prepared by ultramicrotomy. We obtained quantitative chemical maps of the thin sections using energy-dispersive x-ray spectrum imaging with the JSC JEOL 2500 scanning-transmission electron microscope. Additional matrix fragments were crushed on diamond plates and infrared (IR) transmission spectra were obtained from 2.5-25 μm using a Nicolet Continuum IR microscope with HgCdTe detectors.

Results and Discussion: The Acfer 094 matrix material we analyzed is broadly consistent with previous studies [5]. The matrix consists of fine-grained (<1 μm) crystalline silicates and sulfides set in an amorphous silicate matrix. The crystalline silicates include enstatite, forsterite, and diopside, while the sulfides are pyrrhotite with rare pentlandite. Some of the pyroxenes and olivines are Mn or Cr enriched. Rare polycrystalline aggregates occur in the matrix and resemble equilibrated aggregates in CP-IDPs [6]. The amorphous material occurs as 0.2-0.5 μm nodules with minor inclusions of nanophase Fe-sulfides and rare FeNi metal grains. The average composition of these nodules (in at.%, O/Si=4.9, Mg/Si=0.49, Fe/Si=0.93, S/Si=0.21) is richer in O and Fe, and poorer in S compared to average GEMS grains (O/Si=3.3, Mg/Si=0.67, Fe/Si=0.56, S/Si=0.30). The matrix material does not show the order-of-magnitude variation in Mg/Si as do GEMS grains. Unlike most GEMS grains, all of the Acfer 094 matrix nodules contain excess oxygen above that required for stoichiometry, which is consistent with substantial hydration of their silicate matrix. IR spectra of Acfer 094 matrix also show a strong 3 μm water absorption feature that is consistent with gel-like hydrated silicates. High-resolution images however, show a paucity of crystalline phyllosilicates. There are strong chemical and mineralogical similarities between the amorphous silicates in Acfer 094 and experimentally hydrated GEMS grains [7].

Conclusions: The precursors to the amorphous silicates in Acfer 094 were likely GEMS grains that experienced parent body processing that oxidized much of the Fe metal and hydrated the silicate matrix. This processing may have affected the presolar silicate abundance in Acfer 094.

References: [1] Nguyen, A. N. *et al.* (2007) *Ap.J.*, 656, 1223. [2] Bland, P. *et al.* (2007) *MAPS* 42, 1417. [3] Messenger, S. *et al.* (2009) this volume. [4] Keller, L. P. & Messenger, S. (2004) *LPSC XXXV*, 1985. [5] Greshake, A. (1997) *GCA*, 61, 437. [6] Keller and Messenger (2009) *LPSC XL*, 2121. [7] Nakamura-Messenger, K. *et al.* (2007) *70th Met. Soc. Mtg*, 5278.